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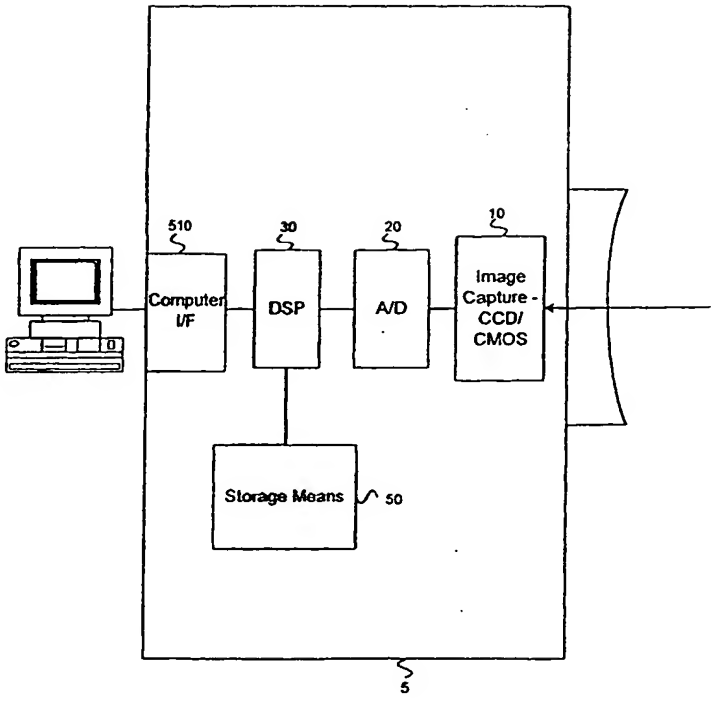
(54) Title: METHOD AND APPARATUS FOR ASSOCIATING ENVIRONMENTAL INFORMATION WITH DIGITAL IMAGES

(57) Abstract

A digital camera configuration (5) including means for capturing a digital image (10), means for storing the captured digital image (50), means for generating environmental associated with a captured digital image (40), and means for storing the environmental information (50), where the environmental information can include, but is not limited to, location information, information regarding the lighting conditions, humidity conditions, temperature, altitude, the odor, orientation of the camera, wind speed and direction, and other like information.



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METHOD AND APPARATUS FOR ASSOCIATING ENVIRONMENTAL INFORMATION WITH DIGITAL IMAGES

Description

BACKGROUND OF THE INVENTION

The present invention relates generally to camera images, and more particularly, to associating environmental information with camera images, particularly digital camera images.

As digital photography increases in popularity, common users will be able to store thousands of digital images, while professional photographers will need to store hundreds of thousands of images. As such, finding a stored image may be quite difficult for the typical photographer.

One possible solution is searching the images for image content. This technique requires the user to specify some characteristic of the image, such as a tall building. A computer searching for the images must then search the images for this characteristic. This technique requires sophisticated software, which has thus far not been completely successful, and is not an efficient method for locating images.

As such, there is a need for methods and apparati to improve ones ability to locate a digital image amidst a plurality of digital images.

DESCRIPTION OF THE INVENTION

Accordingly, the present invention is directed to a digital camera configuration that substantially obviates one or more of the problems due to limitations and disadvantages of the prior art.

In accordance with the purposes of the invention, as embodied and broadly described herein, the invention comprises a digital camera configuration including a digital camera for capturing a digital image, means for storing the digital image, means for generating environmental information, and means for storing the generated environmental information. In another aspect, the digital camera configuration includes means for receiving user information corresponding to a digital image and for storing this information. In yet another aspect of the invention, the digital camera configuration includes means for storing information regarding the camera itself.

The summary of the invention and the following detailed description should not restrict the scope of the claimed invention. Both provide examples and explanations to enable others to practice the invention. The accompanying drawings, which form part of the description for carrying out the best mode of the invention, show several embodiments of the invention, and together with the description, explain the principles of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a block diagram of a digital camera configuration with means for generating environmental information, consistent with the invention;

Figure 2 is a block diagram of a digital camera configuration with a flash and means for generating information regarding the flash, consistent with the invention;

Figure 3 is a block diagram of a digital camera configuration with a camera identification code, consistent with the invention;

Figure 4 is a block diagram of a digital camera configuration with a user interface, consistent with the invention;

Figure 5 is a block diagram of a digital camera configuration with means for generating user information, consistent with the invention; and

Figure 6 is a block diagram of a digital camera configuration with a computer interface, consistent with the invention.

BEST MODE FOR CARRYING OUT THE INVENTION

Reference will now be made in detail to embodiments of the invention, examples of which are illustrated in the accompanying drawings. Wherever possible, the same reference numbers will be used throughout the drawings to refer to the same or like parts.

Figure 1 illustrates a block diagram of a digital camera configuration 5 according to a preferred embodiment of the invention. As shown in Figure 1, the digital camera configuration 5 includes an image capture device 10, an Analog to Digital Converter (ADC) 20, a Digital Signal Processor (DSP) 30, means for generating environmental information 40, and a storage device 50. In a preferred embodiment the image capture device can be a Charged Coupled Device (CCD), but

Complementary Metalic Oxide Semiconductor (CMOS) devices are equally applicable to this invention, as well as other optical sampling devices which generate pixels. The image capture device 10 sends analog voltage information corresponding to image pixels to the ADC 20, which converts the analog signals into discrete binary signals. The digital output from ADC 20 is sent to DSP 30, which adjusts contrast and color balance, and subsequently compresses the image before sending it to the storage 50. The storage device, in a preferred embodiment, includes RAM chips, but in another embodiment, may comprise any appropriate storage medium such as, magnetic disks or memory cards.

In another embodiment, the image capture device 10 can be a complementary metal-oxide semiconductor (CMOS). Because of the nature of CMOS, it is possible to task the CMOS with other responsibilities, such as the Analog to Digital Conversion (ADC) and some signal processing tasks.

In addition to the above, the digital camera configuration 5 of the preferred embodiment also includes means for generating environmental information 40 associated with a digital image. Environmental information includes information relating to the environment in which a digital camera image is captured. For example, environmental information includes location, the lighting conditions, altitude, odor, camera orientation, and various atmospheric conditions, of which temperature, humidity, wind speed and direction are examples. In one embodiment, an Analog to Digital Converter (ADC) is used to convert analog signals which describe the environmental information into a digital form prior to storing the information in storage 50. In another embodiment, the means for generating environmental information generates digital information directly.

In a preferred embodiment, the digital environmental information is sent to DSP 30, which combines the environmental information with the captured image and sends both digital data sets to storage 50.

In one embodiment, the environmental information is stored by storage 50 in files ancillary to the captured digital image. In another embodiment, the environmental information is embedded within the digital image file stored in storage

50 by using fields reserved in that file for user information. In another embodiment, the environmental information is imbedded in the image itself by an encoding technique that modifies the information in the image in such a way that the image visually appears unaltered but the environmental information is recoverable using special techniques. This is sometimes known as watermarking. In this case as well, the digital information is ultimately stored in storage 50.

In a preferred embodiment the means for generating environmental information includes a location-sensing device so that the camera's location at the time of digital image capture can be determined. Location information can include longitude and latitude (as well as altitude) as determined by a Global Positioning Satellite system (GPS), or the latitude and longitude could be converted into an address using maps, such as Sony's Etak system.

In another embodiment, the means for generating environmental information includes a light spectrum analyzer for generating information regarding the lighting conditions at the instant of image capture.

In another embodiment, the means for generating environmental information includes a humidity sensing device, such as solid-state sensor which compares air moisture to a sealed air sample as a reference. Humidity sensors provide digital signals which represent the relative humidity at their sensing location.

In another embodiment, the means for generating environmental information includes a digital thermometer for generating information regarding the temperature when a digital image is captured.

In another embodiment, the means for generating environmental information includes an altimeter to provide information on elevation relative to sea level. Other forms of altimeters could also be used for providing information regarding how high the camera was above the ground when a digital image was captured. Ultra-sonic sensors, which are used to determine distance from the sensor to a reflecting surface, could be mounted on the bottom side of the digital camera to determine the distance from the camera to a support surface. Multiple time samples of this information could be used in this invention to determine if the camera is held by a human being,

with the attendant motion of the camera prior to image capture, or by a tripod or similar device which would have a very constant distance from the camera to the support surface.

In another embodiment, the means for generating environmental information includes a rangefinder for generating information regarding the distance between the digital camera and the object being photographed. The rangefinder can be optical (using edge sharpening techniques) or sonic to provide accurate digital distances from the camera sensor to the object located in the center of the camera viewfinder.

In another embodiment, the means for generating environmental information includes an inclinometer for generating information regarding the orientation of the camera on three axes at the time a digital image is captured.

In another embodiment, the means for generating environmental information includes a gas chromatograph for providing information regarding odors where the digital image is captured. This information can include odors such as bromine and methane, or gas concentrations such as the relative amounts of oxygen or nitrogen or nitrogen-oxides that might be present in the location when the image is captured.

In another embodiment, the means for generating environmental information includes an accelerometer for generating information regarding movement of the camera at the time a digital image is captured.

In another embodiment, the means for generating environmental information includes an anemometer for generating information regarding wind speed and direction at the time a digital image is captured.

In another embodiment, the means for generating environmental information includes a barometer for generating information regarding atmospheric pressure at the time a digital image is captured.

In another embodiment, the means for generating environmental information includes a compass for generating information regarding the direction or orientation of the camera at the time a digital image is captured.

In another embodiment, the means for generating environmental information includes a depth meter for generating information regarding how far underwater the digital camera is at the time a digital image is captured.

As shown in Figure 2, in another embodiment the digital camera configuration 5 includes a flash 110, and means for generating information regarding the flash 140. In this embodiment, the digital camera configuration 5 generates and stores information regarding characteristics of the flash used by the digital camera configuration 5 when a digital image is captured. For example, flash intensity, flash duration, flash orientation relative to the optical axis of the camera, and flash feedback from its sensing element measuring the reflected light coming back from the photographed scene.

As shown in Figure 3, in another embodiment, the digital camera configuration 5 stores a camera identification code 210. In this embodiment, the digital camera configuration 5 stores information regarding the camera identification code for the camera associated with a capture digital image. For example, this code is often a serial number of the camera that is unique to that model of camera. Another example of the camera identification code is the a digital model number or serial number of the lens being used during the photograph, or of the specific type of filter used with the camera, of the specific type of flash unit attached to the camera.

In another embodiment, the digital camera configuration 5 stores information regarding a film identification code associated with film used by the digital camera configuration 5 when a digital image is captured. The film used here might be the type of conventional film used in a dual exposure camera where a digital image and a conventional film image are captured at the same instant. This film type could be specialized optical film to capture different spectra from the scene other than the conventional optical spectra. Examples of these other spectra are Ultraviolet (UV) and Infrared (IR). Sampling of radio wave emissions could be taken at the same time as the digital optical information and that radio wave signal could be digitized and included as part of the environmental identification.

As shown in Figure 4, in another embodiment, the digital camera configuration 5 includes an input/output interface 310. In one embodiment, the digital camera configuration 5 is capable of receiving user information input associated with a captured digital image through a keyboard or digital writing pad via input/output interface 310.

In another embodiment, the digital camera configuration 5 is capable of receiving user information input associated with a captured digital image through a microphone via input/output interface 310.

In another embodiment, the digital camera configuration 5 is capable of receiving user information associated with a captured digital image input through a Personal Digital Assistant (PDA) via user interface 310.

As shown in Figure 5, in another embodiment, the digital camera configuration 5 includes means for generating information regarding an eye of a photographer for a captured digital image 410. This information can include, e.g., information regarding an iris or other part of the eye of the photographer. This information could indicate the retinal pattern of the photographer's eye as a means of uniquely identifying the photographer, or as a means of determining where the photographer was looking into the scene in the viewfinder to help identify the dominant object in the scene.

In another embodiment, the digital camera configuration 5 includes means for generating information regarding a fingerprint of the photographer for a captured digital image. Using an optical window on the side of the digital camera, the photographer's fingerprint could be captured during the scene capture using either the same image capture element as used for the primary scene (typically CCD or CMOS device) or the fingerprint device could be an entirely different sensor. New fingerprint sensors are becoming available which image a fingerprint by non-optical means. This invention covers all types of fingerprint sensor mechanisms.

As shown in Figure 6, in another embodiment, the digital camera configuration 5 includes a computer interface 510 for connecting the digital camera configuration 5 to a computer. Through this interface the digital camera 5 can

receive information associated with a captured digital image from the computer. The digital camera configuration 5 then stores the information received from the computer in a manner that the received information is associated with the digital image. As previously noted, there are two preferred methods for storing this information: in ancillary files, or by embedding the information in the stored image.

While it has been illustrated and described what is at present considered to be the preferred embodiment and methods of the present invention, it will be understood by those skilled in the art that various changes and modifications may be made, and equivalents may be substituted for elements thereof without departing from the true scope of the invention.

In addition, many modifications may be made to adapt a particular element, technique or, implementation to the teachings of the present invention without departing from the central scope of the invention. Therefore, it is intended that this invention not be limited to the particular embodiment and methods disclosed herein, but that the invention includes all embodiments falling within the scope of the appended claims.

WHAT IS CLAIMED

1. A digital camera configuration comprising

means for capturing a digital image (10);

means for storing the digital image (50);

means for generating environmental information corresponding to the digital image (40); and

means for storing the environmental information (50).

2. The digital camera configuration of claim 1,

wherein the means for generating environmental information includes a location sensing device.

3. The digital camera configuration of claim 2 wherein the location sensing device communicates with a Global Positioning Satellite system for generating information regarding a location where the digital image is captured.

4. The digital camera configuration of claim 2 wherein the information regarding the location includes information regarding the longitude, latitude, and/or elevation of the location where the image is captured.

5. The digital camera configuration of claim 4 further comprising,

means for converting the latitude and longitude into an address using a map (30).

6. The digital camera configuration of claim 4,

wherein the means for generating environmental information includes a light spectrum analyzer.

7. The digital camera configuration of claim 1,

wherein the means for generating environmental information includes a humidity sensing device.

8. The digital camera configuration of claim 1,

wherein the means for generating environmental information includes a thermometer.

9. The digital camera configuration of claim 1,

wherein the means for generating environmental information includes an altimeter.

10. The digital camera configuration of claim 1,

wherein the means for generating environmental information includes a rangefinder for generating information regarding a distance between the camera and an object.

11. The digital camera configuration of claim 1,

wherein the means for generating environmental information includes a inclinometer.

12. The digital camera configuration of claim 1,

wherein the means for generating environmental information includes a gas chromatograph.

13. The digital camera configuration of claim 1,

wherein the means for generating environmental information includes a accelerometer.

14. The digital camera configuration of claim 1,

wherein the means for generating environmental information includes an anemometer.

15. The digital camera configuration of claim 1,

wherein the means for generating environmental information includes a barometer.

16. The digital camera configuration of claim 1,

wherein the means for generating environmental information includes a compass.

17. The digital camera configuration of claim 1,

wherein the means for generating environmental information includes a depth meter.

18. The digital camera configuration of claim 1,

wherein the means for generating environmental information includes means for generating information regarding non-visible light.

19. A digital camera configuration, comprising

means for capturing a digital image (10);

means for storing the digital image (50);

means for receiving user information corresponding to the digital image (310);

means for storing the user information (50).

20. The digital camera configuration of claim 19,

wherein the means for receiving user information includes means for receiving information from a keyboard or digital tablet.

21. The digital camera configuration of claim 19,

wherein the means for receiving user information includes means for receiving information from a microphone.

22. The digital camera configuration of claim 19,

wherein the means for receiving user information includes means for receiving information from a Personal Digital Assistant.

23. The digital camera configuration of claim 19, further comprising

wherein the means for receiving user information includes means for generating information regarding characteristics of an eye of a photographer.

24. The digital camera configuration of claim 23,

wherein said characteristics of an eye include at least one of an eye and an iris.

25. The digital camera configuration of claim 19, further comprising

wherein the means for receiving user information includes means for generating information regarding a fingerprint of a photographer.

26. A digital camera configuration comprising,

a flash (110);

means for capturing a digital image (10);

means for storing the digital image (50); and

means for storing information regarding characteristics of the flash (50).

27. A digital camera configuration comprising,

means for capturing a digital image (10);

means for storing the digital image (50); and

means for storing a camera identification code with the digital image (50).

28. A digital camera configuration comprising

means for capturing a digital image (10);

means for storing the digital image (50); and

means for storing a film identification code with the digital image (50).

29. A digital camera configuration, comprising

means for capturing a digital image (10);

means for storing the digital image (50);

means for connecting the digital camera to a computer (510);

means for receiving information from the computer (510); and

means for storing the information received from the computer (50).

30. A method for capturing a digital image and associated environmental information, comprising the steps of

capturing a digital image;

storing the digital image;

generating environmental information corresponding to the digital image; and

storing the environmental information.

31. The method of claim 30,

wherein the generated environmental information includes information from a location sensing device.

32. The method of claim 31,

wherein the location sensing device communicates with a Global Positioning Satellite system for generating information regarding a location where the digital image is captured.

33. The method of claim 31 wherein the information from the location sensing device includes information regarding the longitude and latitude of the location where the image is captured.

34. The method of claim 33, further comprising the step of

converting the latitude and longitude into an address using a map.

35. The method of claim 30,

wherein the generated environmental information includes information from a light spectrum analyzer.

36. The method of claim 30,

wherein the generated environmental information includes information from a humidity sensing device.

37. The method of claim 30,

wherein the generated environmental information includes information from a thermometer.

38. The method of claim 30,

wherein the generated environmental information includes information from an altimeter.

39. The method of claim 30,

wherein the generated environmental information includes information from a rangefinder regarding a distance between the camera and an object.

40. The method of claim 30,

wherein the generated environmental information includes information from an inclinometer.

41. The method of claim 30,

wherein the generated environmental information includes information from a gas chromatograph.

42. The method of claim 30,

wherein the generated environmental information includes information from an accelerometer.

43. The method of claim 30,

wherein the generated environmental information includes information from an anemometer.

44. The method of claim 30,

wherein the generated environmental information includes information from a barometer.

45. The method of claim 30,

wherein the generated environmental information includes information from a compass.

46. The method of claim 30,

wherein the generated environmental information includes information from a depth meter.

47. The method of claim 30,

wherein the step of generating environmental information includes generating information regarding non-visible light.

48. A method of capturing a digital image, comprising the steps of

capturing a digital image;

storing the digital image;

receiving user information corresponding to the digital image.

storing the user information.

49. The method of claim 48,

wherein step of receiving user information includes receiving information from a keyboard or digital tablet.

50. The method of claim 48,

wherein the step of receiving user information includes receiving information from a microphone.

51. The method of claim 48,

wherein the step of receiving user information includes receiving information from a Personal Digital Assistant.

52. The method of claim 48, further comprising

wherein the step of receiving user information includes generating information regarding characteristics of an eye of a photographer.

53. The method of claim 52,

wherein said characteristics of an eye include at least one of an eye and an iris.

54. The method of claim 48, further comprising

wherein the step of receiving user information includes generating information regarding a fingerprint of a photographer.

55. A method for capturing a digital image wherein the digital camera configuration includes a flash, comprising the steps of

capturing a digital image;

storing the digital image; and

storing information regarding characteristics of the flash.

56. A method of capturing a digital image, comprising the steps of

capturing a digital image;

storing the digital image; and

storing a camera identification code with the digital image.

57. A method for capturing a digital image, comprising the steps of

capturing a digital image;

storing the digital image; and

storing a film identification code with the digital image.

58. A method for capturing a digital image, comprising the steps of

capturing a digital image;

storing the digital image;

connecting the digital camera to a computer;

receiving information from the computer; and

storing the information received from the computer.

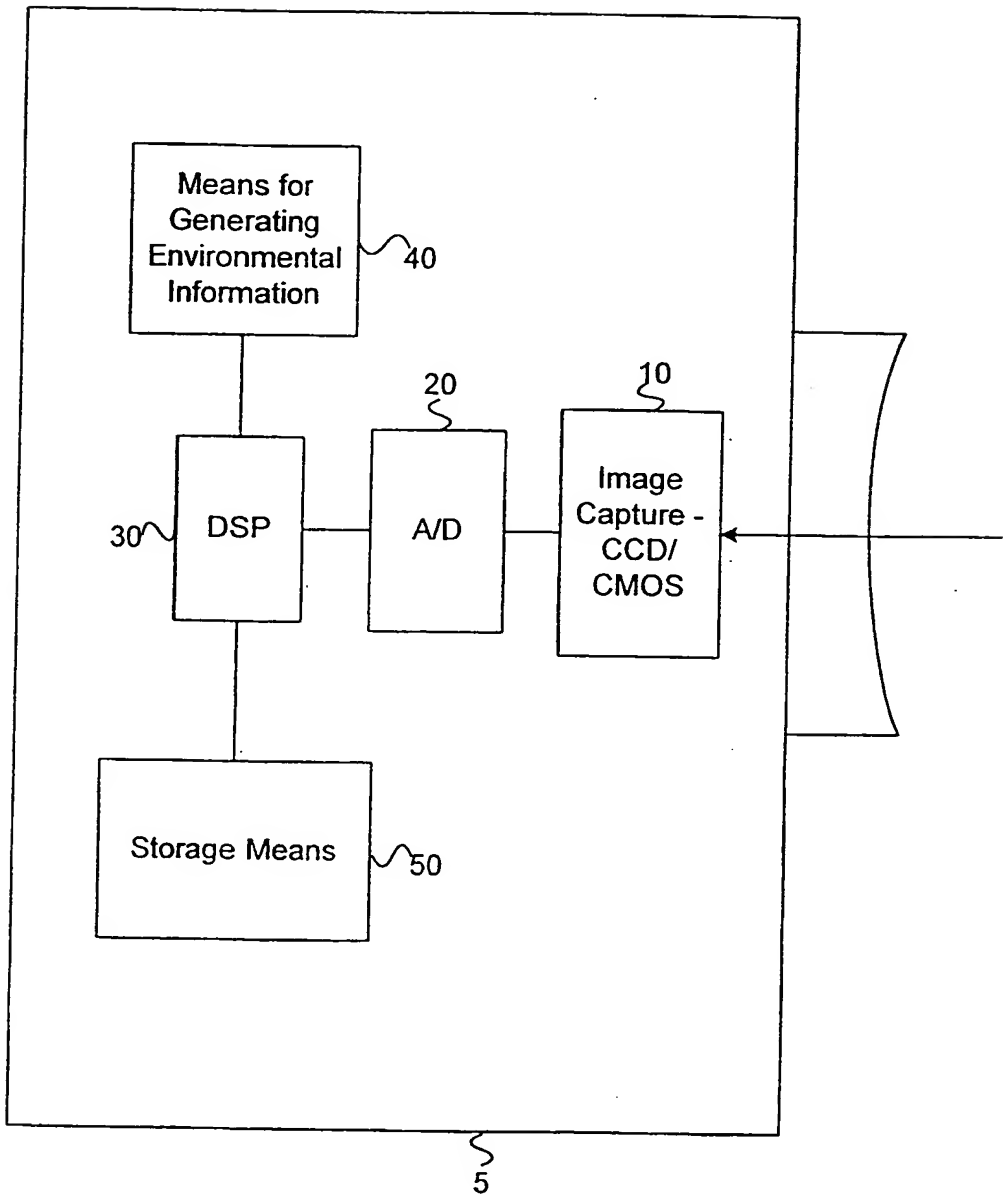

FIG. 1

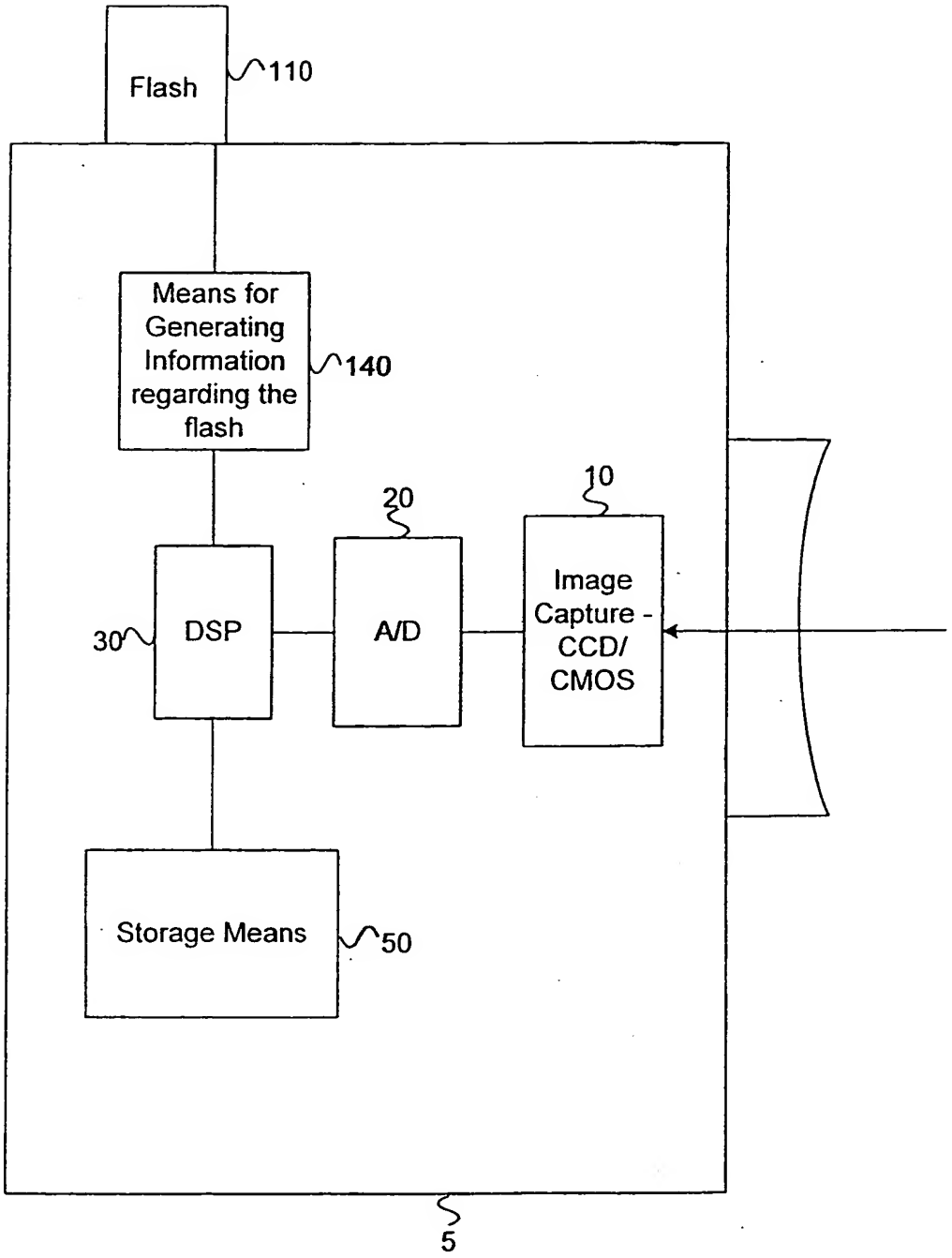

FIG. 2

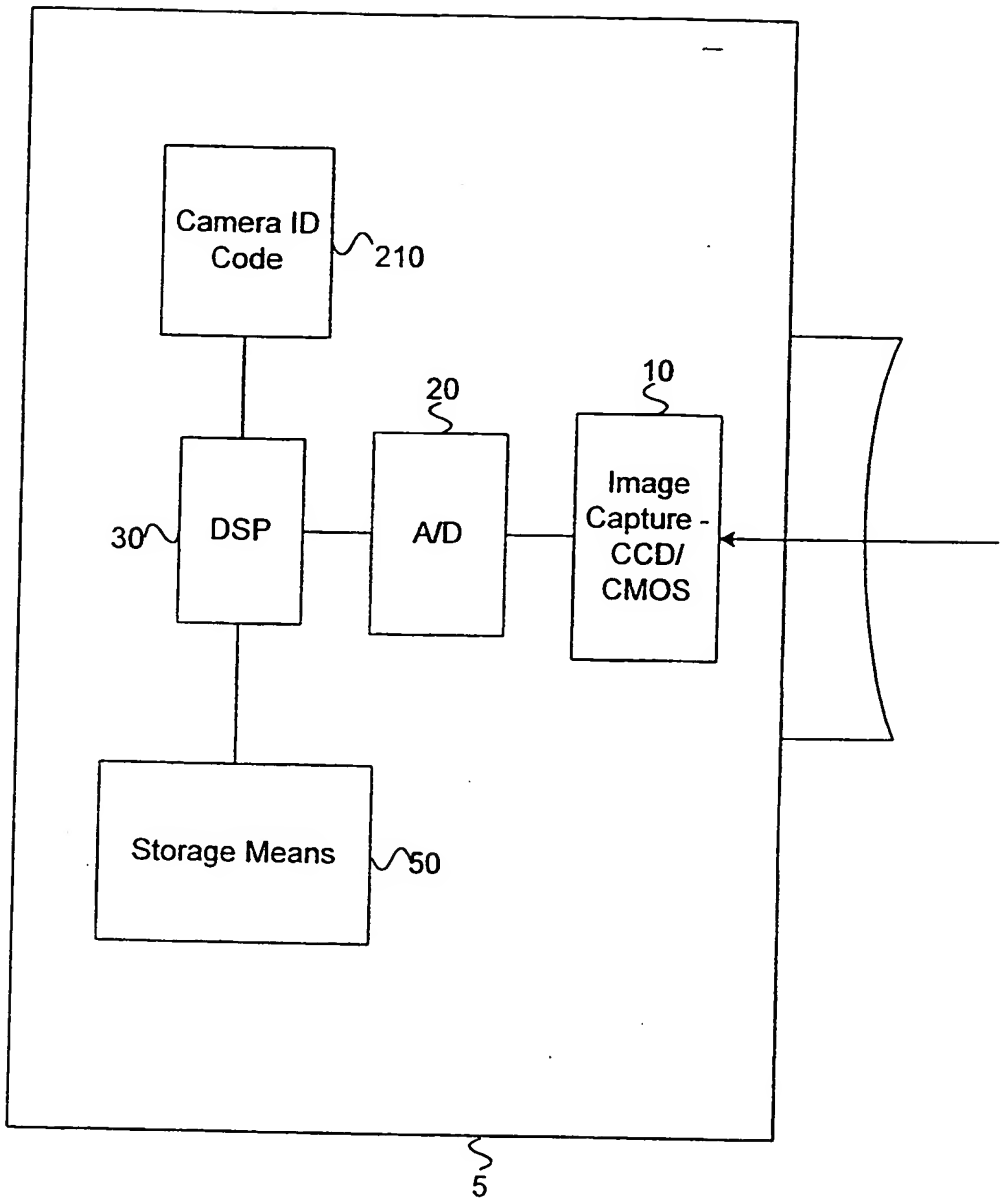

FIG. 3

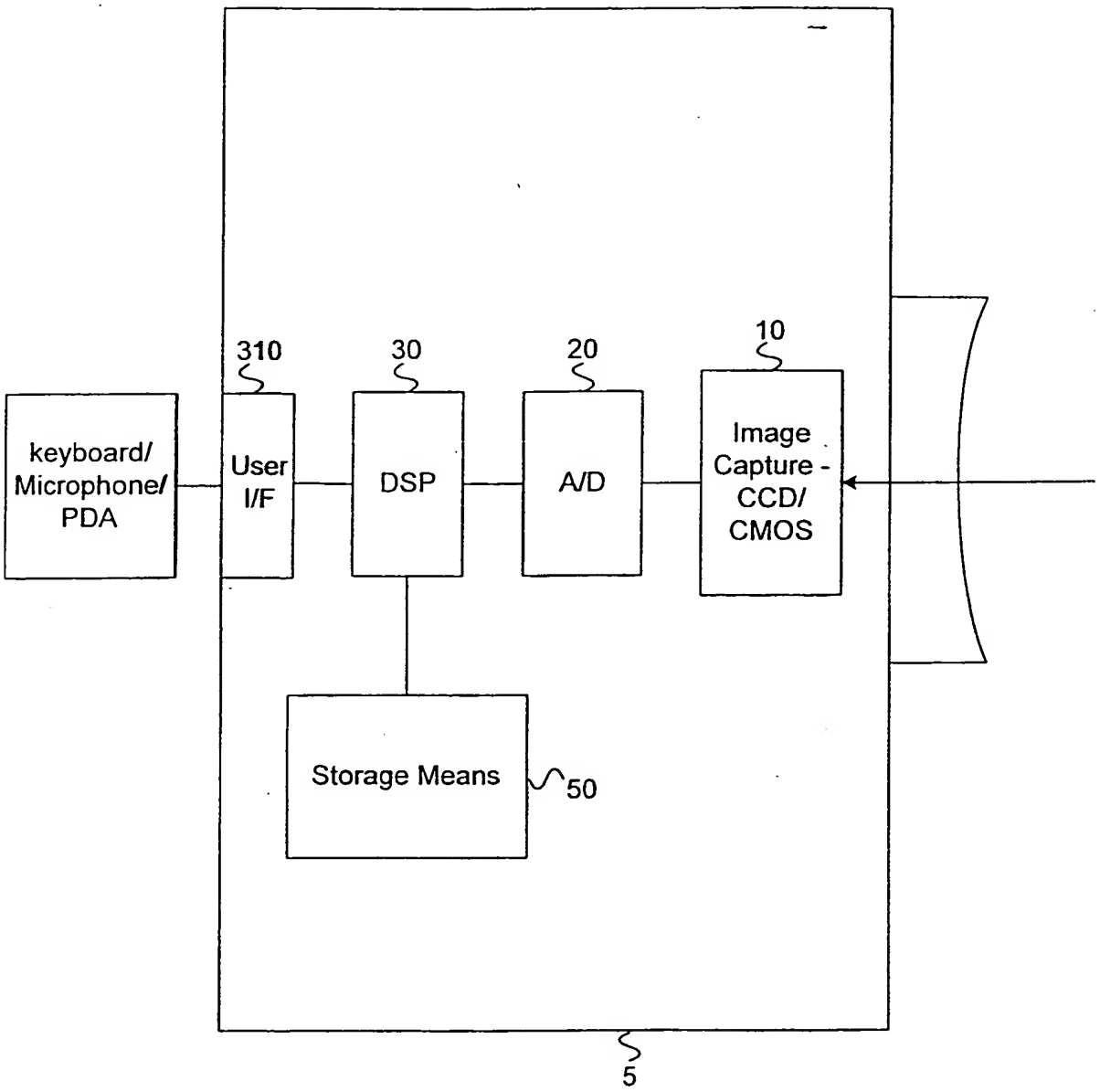

FIG. 4

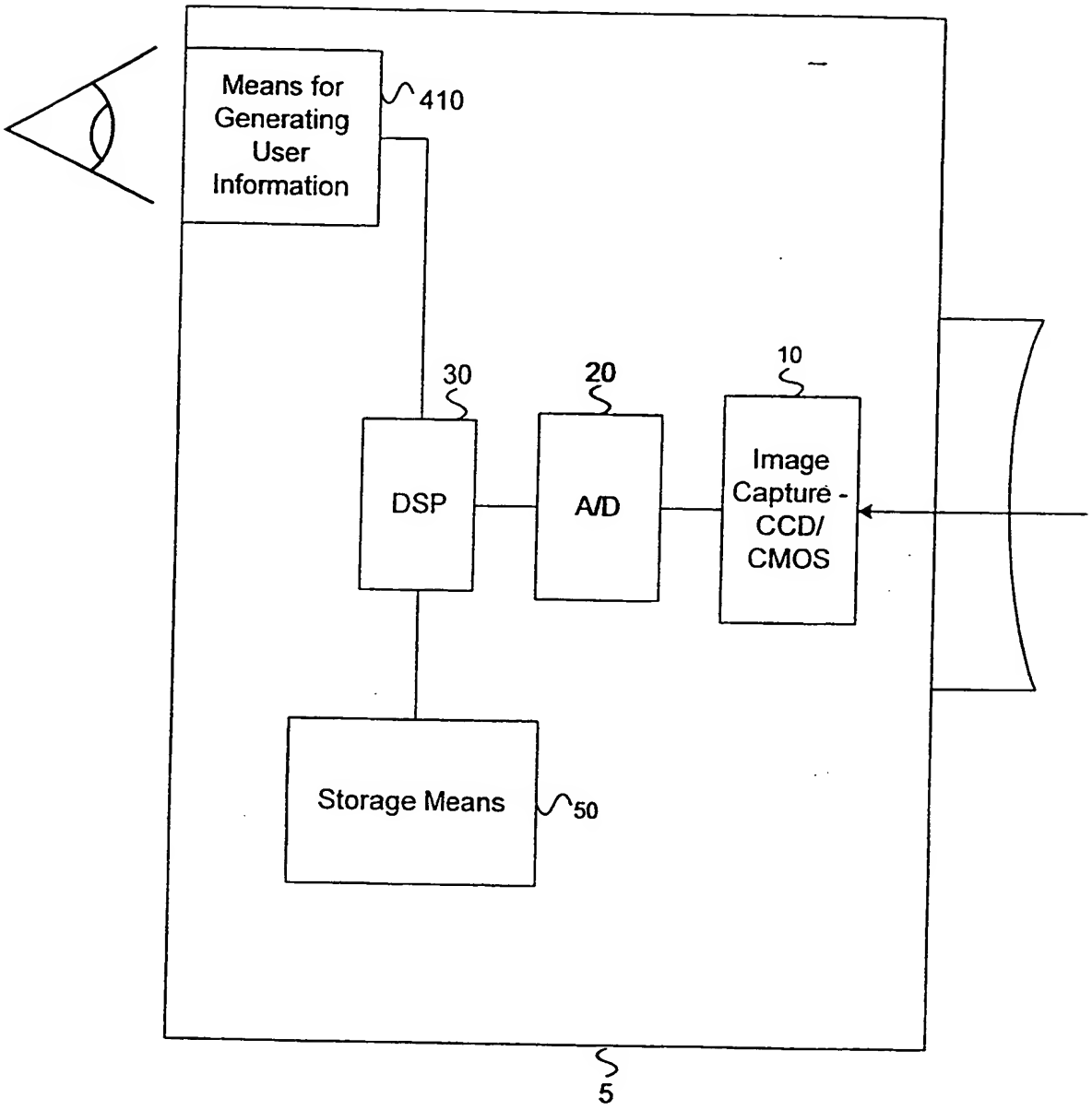

FIG. 5

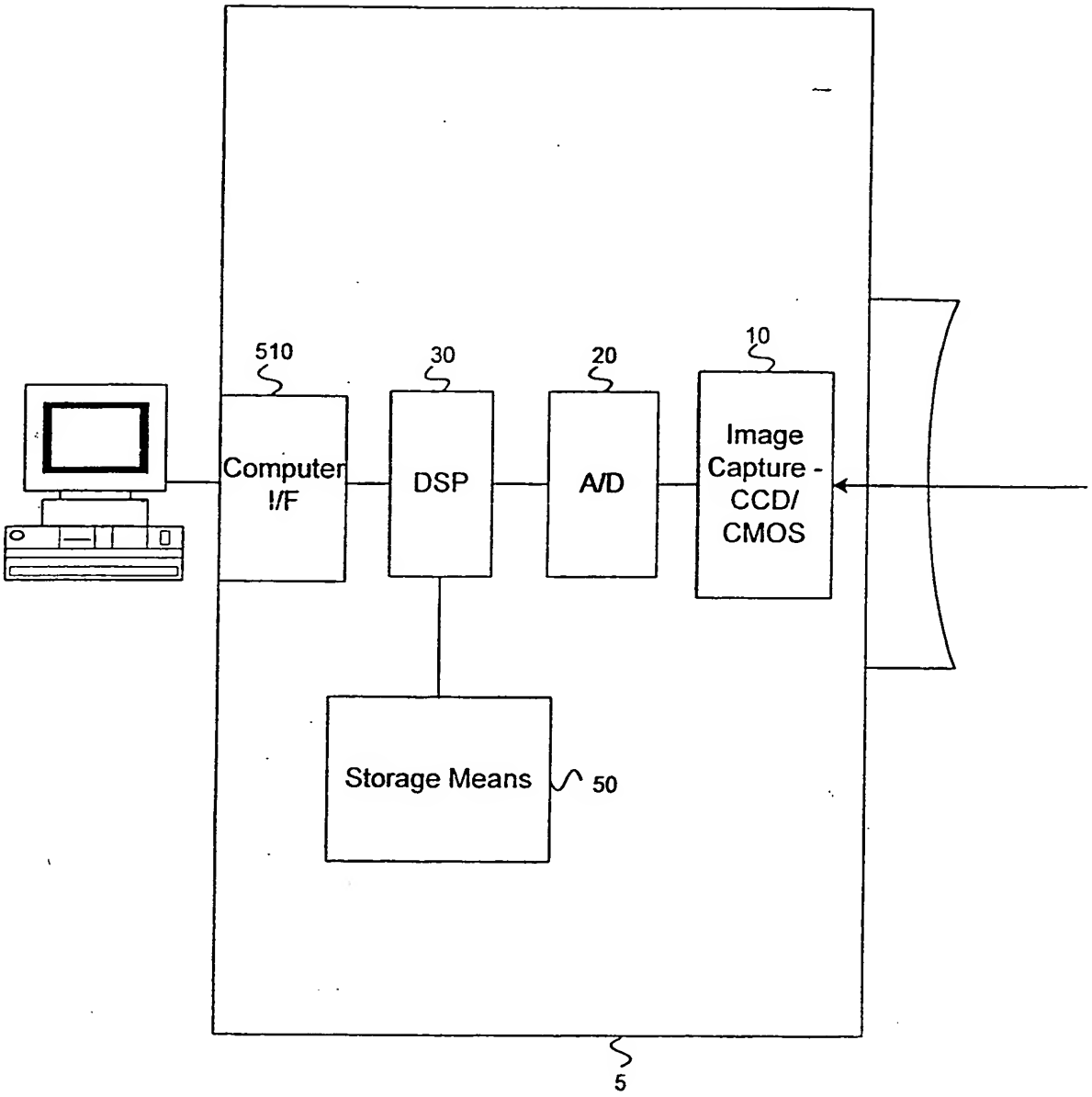

FIG. 6

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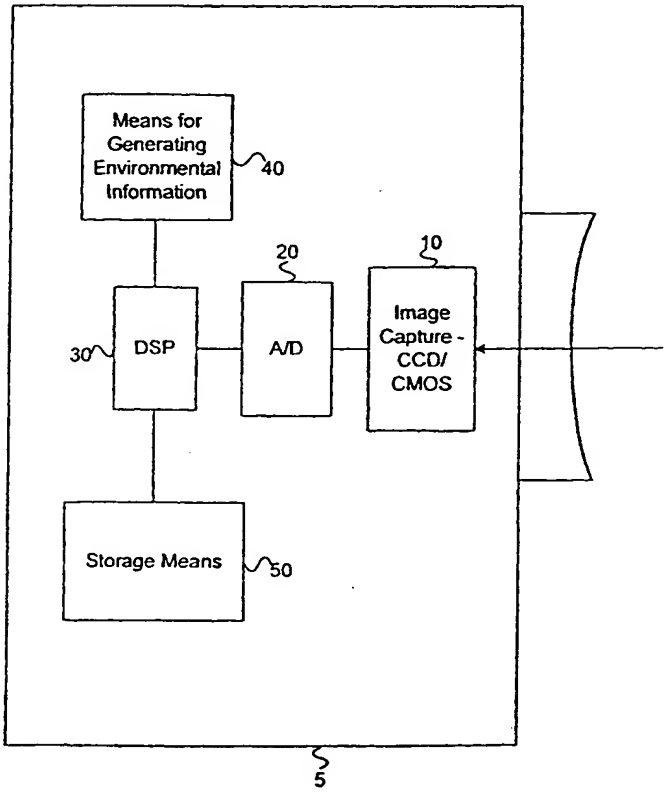
(54) Title: METHOD AND APPARATUS FOR ASSOCIATING ENVIRONMENTAL INFORMATION WITH DIGITAL IMAGES



(57) Abstract: A digital camera configuration (5) including means for capturing a digital image (10), means for storing the captured digital image (50), means for generating environmental associated with a captured digital image (40), and means for storing the environmental information (50), where the environmental information can include, but is not limited to, location information, information regarding the lighting conditions, humidity conditions, temperature, altitude, the odor, orientation of the camera, wind speed and direction, and other like information.

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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US00/01710

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) :Please See Extra Sheet.
US CL :Please See Extra Sheet.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 348/61,78,81,139, 144,207,231,232,233, 371,552; 396/310, 319, 53, 25, 51, 429

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

East BRS search

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X --- Y	US 5,335,072 A (TANAKA ET AL.) 02 August 1994, figure 1A, col. 2- col. 30	1-4, 7-8, 10, 19-22, 30-33, 36, 37, 39, 48-51 --- 5-6, 9, 11-18, 23-25, 34- 35, 38, 40-47, 52-54
Y	US 5,267,042 A (TSUCHIYA ET AL.) 30 November 1993, col. 3,lines 35-65	5, 34
Y,E	US 6,043,494 A (YAMAKAWA ET AL.) 28 March 2000, see abstract and figure 12	6, 18, 35, 47

[X] Further documents are listed in the continuation of Box C. [ ] See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A"	document defining the general state of the art which is not considered to be of particular relevance	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"B"	earlier document published on or after the international filing date	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&"	document member of the same patent family
"O"	document referring to an oral disclosure, use, exhibition or other means		
"P"	document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search 24 JULY 2000	Date of mailing of the international search report 18 AUG 2000
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703) 305-3230	Authorized officer ALICIA M.HARRINGTON Joni Hill Telephone No. (703) 308-9295

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/US00/01710

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5,672,820 A (ROSSI ET AL.) 30 September 1997, see figure 3 and col. 3.	9, 16, 38, 45
Y	US 5,508,736 A (COOPER) 16 April 1996, see figure 1 —	11, 13, 40, 42
Y	US 5,281,826 A (IVANCIC ET AL.) 25 January 1994; see col,. 2.	12, 41
Y,P	US 5,913,078 A (KIMURA ET AL.) 15 June 1999; see figure 28.	14-15, 17, 43-44, 46
X, P ----- Y,P	US 5,991,408 A (PEARSON ET AL) 23 November 1999; col. 2	55 -------- 23-24, 52-53
Y,P	US 5,921,523 A (SOUTH ET AL.) 13 July 1999; see col. 3	25, 54
X	US 5,606,365 A (MAURINUS ET AL.) 25 February 1997, see abstract.	26-28, 56
X	JP Hei-5,-3444460 A (YAMADA ET AL.) 24 December 1993; see pages 1-30.	29, 58
X	US 5,633,678 A (PARULSKI ET AL.) 27 May 1997; see figure 2.	26, 55, 58
X	US 5,768,640 A (TAKAHASHI ET AL.) 16 JUNE 1998; See col. 9.	27-28, 56-57

INTERNATIONAL SEARCH REPORT

International application No.
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A. CLASSIFICATION OF SUBJECT MATTER:
IPC (7):

H04N 7/18, 5/225, 5/76, 5/222, 7/00; G03B 17/48, 17/24, 17/50, 17/00, 17/08

A. CLASSIFICATION OF SUBJECT MATTER:
US CL :

348/61,78,81,139, 144,207,231,232,233, 371,552; 396/310, 319, 53, 25, 51, 429

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